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The *Kepler* Planet Detection Pipeline

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Abstract

The *Kepler* Science Pipeline provides calibrated pixels, simple and systematic error-corrected aperture photometry, and centroid locations for all 165,000 Long Cadence (LC) target stars sampled at 29.5 min integrations, along with associated uncertainties. The *Kepler* data products are available on the Multi-mission Archive at STScI (MAST) *Kepler* website, http://stdatu.stsci.edu/kepler. The Transiting Planet Search (TPS) module searches through all light curves for evidence of periodic transit signals that occur when a planet crosses the disk of its host star. The Data Validation (DV) pipeline module calculates a suite of diagnostic metrics for each transit-like signature discovered, and also extracts planetary and stellar parameters by fitting a limb-darkened transit model to each potential planetary signature. Based on the first 120 days of data collected by *Kepler*, over 1200 planetary candidates have been identified, including a plethora of multiple transiting candidates, and at least 16 confirmed or validated planets have been announced.

We describe upcoming improvements to the Pipeline currently under development that will become available in late 2011. Highlights include a Bayesian Maximum A Posteriori (MAP) approach to identifying and removing signatures of instrumental systematic errors in the Pipeline module Pre-search Data Conditioning (PDC). Other features under development include a redesigned detector for occasional sudden pixel sensitivity dropouts (SPSDs), which are radiation-induced drops in the quantum efficiency of individual pixels. In addition, TPS will incorporate a robust detection statistic to allow for spurious events, such as those caused by SPSDs, to be ignored, thereby improving the completeness of the planetary search. We provide examples of the light curves and other data products provided by the Science Pipeline.

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1 Introduction

This paper provides an overview of the *Kepler* Science Pipeline and highlights improvements and extensions available with Science Operations Center (SOC) Build 7.0. These changes allow TPS to search multiple quarterly segments of data for signatures of transiting planets, and DV to fit limb-darkened transit models to the light curves identified with transit-like features across the entire data set accumulated to date. Additional new diagnostics provided for each candidate include pixel-based metrics to assist with identifying background eclipsing binaries in an automated fashion. We describe the performance of this software, which represents the first complete version of the *Kepler* Science Pipeline.